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BRIGHT SUNSHINE IN 1906.

By R. H. Curtis.

From a meteorological point of view, the year which has recently closed was a remarkable one in more than one respect, and not least so in regard to the amount of sunshine with which we were favoured; and an account of the distribution of this element of our climate during the year may not be without interest. But in attempting this task we meet with an initial difficulty in the comparatively small amount of instrumental data available for the purpose, and in the unequal apportionment of the data we do possess to different portions of the country. Although a sunshine recorder is now getting to be regarded as a necessary item in the equipment of a meteorological station, there is still a large number of observers who do not possess one, and in consequence there are quite large areas of the country which, so far as their sunshine capabilities are concerned, are wholly unrepresented.

In some districts, however, sunshine recorders are fairly numerous, and for such regions the distribution of bright sunshine can be summarised with considerable accuracy; but for the less favoured, though probably not less important, districts, where the instruments are few and widely apart, the deductions drawn from the available data can only be regarded as more or less close approximations to the truth.

For the present brief discussion of the sunshine of 1906 the data employed have been derived from one hundred recorders of the Campbell-Stokes (burning) pattern, distributed over the British Isles from the Orkneys to the Channel Islands, and from the coast of Norfolk to that of Kerry. The number is obviously too small to represent fully so large an area, but it is, I believe, the largest which has hitherto been available for any similar purpose.

The data have been dealt with in two ways—one being to use the number of hours of bright sunshine actually registered, and the other to take into consideration the possibilities of the station, as regards its geographical position and the season of the year, and then express the number of hours recorded as a percentage of the total number

possible, supposing the sun to shine without interruption from sunrise to sunset; purely local conditions by which the horizon of the recorder may have been curtailed have not been taken into consideration.

Dealing first with the aggregate number of hours recorded in the year, the distribution—not the actual number—over the kingdom followed pretty closely that of an average year, the largest totals being found at the coast stations, and the *isohels*, or lines of equal duration, showing a marked tendency to follow the trend of the coast, as indicated on the accompanying map. The most favoured region was the English Channel and its junction with the North Sea, 2000 hours being approximately the amount recorded at every station along the coast from Torquay to Lowestoft. Inland the amount became less, but still the whole of the region south of a line drawn from the Humber to the Bristol Channel received, broadly speaking, over 200 hours more than its average yearly amount of sunshine. The smallest aggregate was that received by the north-western portion of Scotland, where it fell below 1200 hours, an amount which does not differ greatly from the average for that region. Regarding the results for the year in another way, there were 22 weeks in which the south of England was favoured with more than the average duration of sunshine; as many in which the amount was normal; and only 8 weeks in which there was a deficiency. Over the north-eastern portion of England, which also was a very sunny region last year, there were no fewer than 27 weeks with more than average sunshine, and only 9 with less than the average; while the north of Scotland had only 15 weeks which were relatively sunny.

Coming now to the individual months; the two which were least sunny, relatively to their possible amounts, were *May* and *November*, in both of which months the total number of hours recorded was nearly everywhere considerably below the average. These months, however, were exceptional, and in no other month was there such a general falling off in the records. The most brilliant months were—*February*, when many places, especially those in the north, received nearly 40 per cent. of their possible amounts; *April*, when the average amount was exceeded everywhere, the percentage of the possible amount rising at Falmouth to 66, whilst the recorded totals exceeded 250 hours at many places; and *June*, *July* and *September*, which were also exceptionally sunny months, especially the last named, when not only were the totals relatively larger, but the average amounts were also more generally exceeded than in the two earlier months. During the remaining five months of the year the departures from the averages were less regular, but in each case the southern and south-eastern districts were again well off for sunshine, whilst the north-western and south-western districts, as well as the more northern and western, received only a little above, and sometimes indeed considerably below, their average amounts.

Our space will not admit of much being said as to the correlation

of the amount of sunshine with the other meteorological factors of our climate. Of course the sunshine results are primarily related to the system of wind circulation which prevailed and brought with it, especially to the southern half of the kingdom, the clear skies which made the bright sunshine possible; in their turn the winds were controlled by the prevailing types of pressure distribution. In the two months of low sunshine records the pressure was lower than the average, and the weather was disturbed and unsettled, numerous depressions passing over or near our Islands. High pressure accompanied the fine weather of April, June and September, with their large records of sunshine; and nearly normal pressure conditions prevailed in the other months of the year, but with occasional spells of anticyclonic weather accompanied by light winds and less than the usual amount of cloud.

THE RAINFALL OF 1906.

METEOROLOGICALLY, the outstanding feature of 1906 was the remarkable abundance of sunshine; the rainfall was on the whole of little interest, though many of the details are deserving of the study which in due time they will receive. The concluding columns of the Rainfall Table on p. 241, summarise the rainfall of the year as compared with the 30 years' average used in these pages. The limited number of stations dealt with in the Table prevents us from speaking definitely as to the wetness of the year at so early a date, but the provisional deductions are confirmed by a necessarily incomplete comparison with the very large number of returns already sent in for *British Rainfall, 1906*. If the average rainfall in each case is taken as 100, the general rainfall for England and Wales in 1906 comes out as 100, or exactly the average; that for Scotland as 109, or 9 per cent. above the average; and that for Ireland 96, or 4 per cent. below the average. Viewing the British Isles as a whole, the figure is 101, or an excess of 1 per cent., so that we cannot be far wrong in speaking of 1906 as an average year with respect to the total amount of rain. The driest station which has so far been observed is Ross in Herefordshire, with a deficiency of 25 per cent.; the wettest is Dunrobin in Sutherland, with an excess of 31 per cent. Very few stations showed such great extremes, and the general distribution of rain over the country may be described as follows:—

A dry belt stretched across the centre of England from the East Riding of Yorkshire to South Devon, and a branch from it extended eastward down the Thames valley into Kent. A small patch on the north-west coast of England, and another round the Firth of Tay, were also dry, and the whole of Ireland, except the west and north-west. The only district in Great Britain, however, in which there was anything like a serious deficiency, was a narrow strip running from South Devon to near Derby, and including the middle valley of the

Severn. Here the rainfall was less than 90 per cent. of the average, and at Ross it was only 75 per cent. A deficiency of more than 10 per cent. prevailed over the south-east of Ireland.

The regions with excessive rainfall, exceeding 10 per cent., included a patch in the east of Norfolk, another in the extreme north of Scotland, where Dunrobin had an excess of 31 per cent., and a long narrow area in the centre of Great Britain, including the Pennine range in eastern Lancashire, and the west of the West Riding of Yorkshire, and extending north-westward across the Southern Uplands of Scotland and the Firth of Clyde to the shores of the Firth of Lorne. In the west and north of Ireland small wet patches also occurred.

Had the sequence of two dry years followed by a wet year held good, as it did for the previous fifteen years, 1906 should have been wet. The more detailed discussion of the data which will appear in *British Rainfall* may possibly show that the general rainfall of the country was decidedly above the average, but at present we must suspend our opinion on the matter.

THE CHRISTMAS SNOWSTORMS OF 1906.

In view of the widespread nature of the snowstorms which formed so marked a feature of the past Christmas, and which occupied so largely the attention of the Press during the holiday season, opportunity was taken of asking the whole of the observers of the British Rainfall Organization to supply information as to their character in their individual localities. The liberal response with which this request was met has had the effect of embarrassing us, for the time at least, with a somewhat unmanageable mass of raw material, rich in promise for future investigation, but from which it is difficult at so short notice to extract more than a few generalities.

As early as December 23rd the prevailing high atmospheric pressure over the British Isles began to give way, and by the following day a brisk fall of the barometer was taking place over the north of Scotland. On the evening of the same day a well-defined cyclonic system located itself over the south of Norway, and subsequently increased greatly in depth and gradient. The temperature, which had risen slightly on the 24th, now fell almost everywhere, and frosts were recorded on the 25th and 26th in most parts of Great Britain. On the evening of the 25th a secondary depression became evident over the north-west of Ireland, and later another large system formed with its centre over the Strait of Dover. The conditions were thus favourable for cold north-westerly winds, of considerable force over the North Sea, and decreasing to the westward.

Snow began to fall generally during the evening of the 25th, or early morning of 26th, and in England the greater part was deposited during this night. In some parts of our Islands, however, heavy

falls took place during the following four days, and for the present purpose it is found expedient to discuss the total depth from 26th to 30th as a whole.

During this period the whole of the British Isles, with some trifling exceptions in south Dorset and on the coasts of the Bristol Channel, was visited with snowfalls of more or less severity. Indeed, the districts in which less than an inch fell were almost negligible, being confined to south-east Wales, part of Wessex, some places in the south and east of Ireland, and also a tract between Edinburgh and Glasgow. Considerably more than half the Kingdom received a fall greater than five inches in depth, the most important exceptions being the whole of England south-west of an irregular line crossing the country from the Solway Firth to Brighton, except some patches in the upper Thames Valley. A somewhat lighter fall also took place in south-east Yorkshire, Bedfordshire, and parts of Essex. The north and central uplands of Wales probably exceeded the five-inch limit, although insufficient data make it unsafe to speak definitely of the remoter districts of the Principality. In East Anglia a large and fairly well-defined area, including most of the south of Norfolk and the north of Suffolk, lay under snow exceeding ten inches in depth, and as much as fourteen inches was reported from Wymondham. More than ten inches fell over the northern extremity of the Chilterns, but this was confined to a quite small area. Between Lincoln and Newark also, nearly a foot undoubtedly fell. The part of England, however, which suffered most severely was a strip including the more elevated portions of the county of Durham, and stretching along the east coast of Northumberland into the southern uplands of Scotland. Eighteen inches fell near Morpeth, and probably about a foot over the upper valleys of the Tees and Wear. About the same amount is reported from Berwickshire and Peebleshire. The basins of the Clyde and Forth, together with large tracts in southern Perthshire and Argyll, escaped comparatively lightly, but to the north of this there seems to have fallen almost everywhere a covering of a foot in depth, reaching upwards of two feet in Kincardine and probably also in southern Aberdeenshire. A strip with less than five inches however occurred round the shores of the Moray Firth.

Although the greatest depth recorded was undoubtedly in Scotland, the extent and severity of the storm in Ireland was certainly more noteworthy owing to the usual immunity of the Emerald Isle from heavy snowfalls. More scattered information than exists for Great Britain render positive assertions unsafe, but as far as the data can be relied upon to represent the facts, the whole island north of the latitude of Dublin, apart from the sea borders, received above five inches, an instance of widespread deep snow probably almost unique for Ireland. More than a foot is also reported from several stations in the north and west, and it seems probable that this amount fell over large districts. It is interesting to note the

coincidence of the most affected part of Ireland, with the small secondary barometric depression which formed in this locality, and during the influence of which the greater part of the fall seems to have taken place.

The severity of the storm occasioned much suffering in many localities. Numerous deaths from exposure have been reported; trains were snowed up in the south of Scotland, and for three days Aberdeen was isolated by blocked railways and broken telegraph wires. The most serious disaster was a railway collision near Arbroath, attended by much loss of life.

ATMOSPHERIC PHENOMENA DURING THE CHILE EARTHQUAKE.

By William Gaw, Santiago.

In view of the interest occasioned by the terrible earthquake which visited the central part of Chile on August 16th, I bring forward some data relative to the atmospheric phenomena observed in Santiago just before and after the seismic movements. I may here advert to the fact that the Meteorological Section of the Chilian Navy in Valparaiso, about seven days previous to the catastrophe, prognosticated some atmospheric or seismic disturbances for that day in the following terms, translated from the local newspapers:—

The Meteorological Section of the Direction of Marine Territory has prognosticated atmospheric or seismic phenomena for the 16th of the present month, based on the following observations:—

On the said day there will be a conjunction of Jupiter with the Moon and maximum of northerly declination of the Moon. Owing to these positions of the planets the circumference of the dangerous circle passes Valparaiso.

The above prediction naturally arrested my attention, although I confess I was rather sceptical as to any seismic disturbances being produced by the conjunction of Jupiter with the Moon. The forecast was virtually ignored by the general public, who take little or no interest in atmospheric phenomena, the only living interest taken in these matters being found amongst the officers and officials of the Chilian Navy.

Santiago Observatory is situated in latitude 33° 26′ 42″ South, longitude 70° 41′ 36″ West of Greenwich, at an altitude of 1706 feet above sea level. The mean annual barometric pressure for Santiago is 28·23 inches.

The following table is issued by the Astronomical Observatory as an approximate guide for weather forecasts in Santiago:—

	inches.
Good weather fixed	28·60
Good weather	28·41
Variable	28·23
Rain	28·05
Storm	27·87
Hurricane	27·70

The comparatively small range between the minimum (27·70 in.) and the maximum (28·60 in.) of the barometric fluctuations is worthy of remark, but, as is well known, the oscillations in high latitudes are much greater than those near the tropics. The greatest monthly variation recorded since 1860 was ·60 in., in June, 1903. A monthly variation of ·44 in. is abnormal and very rare. The *total* variation since 1860 has been ·90 in. (August, 1865, 28·67 in., and June, 1905, 27·77 in.)

Bearing in mind the forecast for August 16th, we carefully watched the movements of the barometer, hygrometer and thermometer, with the object of detecting anything which might indicate the fulfilment of the prediction issued by the Meteorological Office in Valparaiso. The first sign of anything unusual was on the evening of the 11th, at 9 p.m., when rain began to fall and continued during the following day up to 4 p.m. The amount of rain during these 19 hours was 1·97 in. The prevailing wind was from the N., with a maximum velocity of 30 miles per hour. On the 12th nothing in the weather attracted attention. On the 13th we had a S.W. wind blowing all day, accompanied by a very high barometer. The following are the readings for that day and the days following :—

1906.	AUG. 13.		AUG. 14.		AUG. 15.		AUG. 17.	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Temp. (shade).	41°·2	48°·0	32°·9	48°·6	44°·1	52°·9	45°·3	57°·4
,, (exposed).	41°·0	59°·0	28°·4	47°·3	30°·2	54°·5	44°·2	79°·7
Bar. (inches)...	28·30	28·52	28·40	28·52	28·08	28·38	28·36	28·37
Rel. Humidity	76%	95%	52%	99%	84%	97%	65%	95%

Notwithstanding the conditions on the 13th, we had that day heavy showers of rain. This infrequent phenomenon courted special mention in the readings issued by the Astronomical Observatory in Santiago. A similar phenomenon was observed on the 14th—*i.e.*, high barometer accompanied with rain.

A decided change in the barometric pressure took place on the 15th, as shown in the foregoing table. There was a very pronounced drop of the barometer within 24 hours, something very unusual for Santiago. On the 16th, Valparaiso, Santiago and surrounding districts were visited by a terrible earthquake, causing enormous loss of life and property in the former city. As no meteorological readings for the 16th were published I am unable to furnish figures. The first shock came at 7 h. 58 m. 44 s. p.m., without any previous warning, and continued till 8 h. 3 m. 34 s. ; direction N. to S., duration 4 m. 50 s. This was immediately followed by another shock at 8 h. 7 m. 30 s. with 20 minutes' duration. The latter shock was the severest and most destructive of all. Up to 5 a.m. the following day we experienced 23 shocks at different intervals. Copious rain fell for some hours before the first shock and continued until about 10 p.m. At the time of writing (October 20th) 106 shocks have been recorded by the seismograph in Santiago. At the moment of the catastrophe the heavens presented a most unnatural hue.

Electrical discharges were numerous, and it seemed as if the sober laws of physics had revolted. The writer cannot recall with precision the exact atmospheric conditions prevailing at the moment of the great disturbance, though he has more than a vivid recollection of that never-to-be-forgotten night. On the 17th, as shown in the Table, the atmospheric conditions appeared to be more or less normal once more. The subsequent readings showed nothing unusual except that they were marked by high barometric pressure until the 21st.

From the data brought forward we deduce the following :—

(1) The third and second days previous to the great shocks were characterised by a high barometer accompanied with rain—abnormal conditions here. (2) The day preceding the first seismic movement (15th) was marked by a sudden fall of about half-an-inch of barometric pressure in a comparatively short period of time.

The cause and import of such a fluctuation is perhaps difficult to determine, but the writer is of opinion that there was some relation between the earthquake of the 16th and the atmospheric phenomena observed before and after it. He is also convinced that there is interesting and instructive information to be acquired by carefully observing all atmospheric phenomena that precede seismic movements all over the globe. That there is *some* relation between atmospheric perturbations and seismic tremors few will deny ; and it may not be too much to anticipate that in future observers in meteorology will play their part in contributing data that will help to determine the genesis of seismic phenomena. Until we possess a more perfect knowledge of the physical conditions existing a few miles beneath the Earth's crust we should be content to be tentative and not dogmatic in our assertions. Statements emanating from such authorities as Professor J. Milne and the Hon. R. J. Strutt are pregnant with deep import and open up unlimited fields of research to the intelligent observer.

ROYAL METEOROLOGICAL SOCIETY.

THE monthly meeting of this Society was held at the Institution of Civil Engineers, Great George Street, Westminster, on Wednesday evening, December 19th, Mr. Richard Bentley, President, in the chair.

Admiral J. P. Maclear read a paper on "The Guildford Storm of August 2nd, 1906." This storm showed some very curious and interesting features, in the remarkable violence of the wind, rain and hail, within a small area, and the suddenness with which it burst. There was an area of thunderstorms over the whole of the south of England on the evening of that day. The most violent storm, however, burst over Grayshott on Hindhead at 8.20 p.m., and pursued a narrow track through Godalming and Guildford to

Ripley, five miles north-east of Guildford. The wind was of hurricane force, and blew down an immense number of trees and caused other damage and also the loss of two lives. The rain, accompanied by large hailstones, was very heavy, as much as 1·17 in. falling at Grayshott in 15 minutes. There was a magnificent display of lightning, the flashes being incessant and darting from cloud to cloud. The observer at Charterhouse School, Godalming, gave the following interesting account, which shows the intense character of the storm:—

"At about 8.35 a few splotches of rain, a roar of the whirlwind, and then such hail and rain as I had never witnessed before, and trust may never again; the noise was deafening, as though hundreds of loads of gravel were being shot from on high against the window panes, while all the while the thunder bellowed and crashed overhead. My front door was open when the tornado burst, and I had great difficulty in shutting it; but even in those few moments my hall was flooded, curtains, mats and rugs blown upstairs, and a bucketful of hailstones, as large as sparrow's eggs, deposited at the foot of the stairs.

"In about eight minutes it was all over: the sky resumed its tranquil aspect as though nothing had happened, and the storm rolled quickly away to the north-east. The barograph in the library showed at the onset of the storm, at 8.35, a jump of $\frac{1}{5}$ of an inch, and immediately a fall of $\frac{3}{20}$, then gave a slight 'kick' and a steady rise. The rainfall during the eight minutes was ·77 in., though there was probably rather more, as hailstones often jump out of the funnel of the rain gauge.

"The region of maximum violence in our neighbourhood was undoubtedly from Hurtmore Bottom to Guildford. The breadth of the disturbance was about 2 miles; its north-west boundary lay between Priors Field and Puttenham, probably nearer the former, for Shackleford escaped serious damage."

An interesting discussion followed the reading of this paper. Dr. Theodore Williams referred to the damage done to the trees in his immediate neighbourhood at Witley.

Mr. W. H. Dines said that the storm seemed to have taken a track a little north of the railway from Guildford to Surbiton, ending in the neighbourhood of Oxshott.

Mr. W. Marriott showed some photographs of lightning taken during the storm, and stated that it was reported that in London there were over 600 flashes in 52 minutes. He also referred to the severe hailstorm which occurred on the same evening on the borders of Bedfordshire, Cambridgeshire and Huntingdonshire, where considerable damage was done. He thought that the jump in the barograph trace was largely due to the compression of the air caused by the sudden heavy rainfall.

Mr. R. G. K. Lampfert enquired whether the trees were all blown down the same way. He also stated that he had collected a large

number of records for that day from all parts of the country, but had not been able to get any satisfactory results from them.

Prof. A. S. Herschell described an effect of the lightning on the same evening in the north of England. A large hole was made, and the sod was hurled a distance of 25 yards.

Dr. W. N. Shaw, Mr. F. C. Bayard, Mr. T. P. Newman, Mr. W. B. Tripp, Capt. A. Carpenter, and the President also spoke, and Admiral Maclear replied.

The following were elected Fellows of the Society :—Mr. R. M. Balston, Capt. K. E. Digby, Major G. R. Elliot, Major G. E. Galbraith, Capt. A. A. C. Galloway, Capt. C. G. Manners, Mrs. H. R. Mill, Mr. R. Mond, Major C. Peters, Mr. H. Reid, M.Inst.C.E., Capt. E. J. W. Slade and Mr. W. Wilson.

LIGHTNING CONDUCTORS.

On December 6th, Mr. Alfred Hands delivered a lecture before the Royal Engineers at Chatham, on "The Protection of Buildings from Lightning." He showed the extent of damage by lightning by means of a chart of England and Wales, on which the positions and nature of objects damaged during a period of about nine years were indicated by coloured spots. This included 2,485 buildings, of which 148 were churches. He criticised the Report of the Lightning Research Committee, which, he said, by its contradictory recommendations and incorrect statistics, had caused a great deal of scepticism as to the utility of lightning conductors. He showed by diagrams and reproductions on models of buildings of cases that had occurred, some of the more complex lightning effects that had to be guarded against, and the methods of protection that had to be employed. These included fires caused by the surging effect of a discharge, and cases in which damage is caused to a building by lightning striking an object half a mile away.

The lecturer showed the impossibility of protecting buildings efficiently by means of set rules; each case had to be studied separately, and the system of protection applied which the complications of metal in and about the structure showed to be necessary. Hitherto too much importance had been attached to the form and composition of the conductor, and too little to the fact that its efficiency depended almost entirely on the way in which it was applied, and very little on what it was. He regarded the subject as somewhat analogous to the work of a medical practitioner. The conductors in the hands of an expert were comparable to the drugs a physician might find it neccessary to prescribe according to his diagnosis of the case. No one could claim infallibility, and anyone might overlook some factor that might have an important bearing on the case; but the fact remained that the possession of knowledge, experience, and an ability to discriminate as to the importance of details should enable a man

to protect a building effectively, while absence of these would very probably result in failure. At all events, it was in this direction he thought we should strive to improve our methods, and not in trying to devise theoretically perfect, but practically impossible mechanical arrangements.

As regards the relative value of iron and copper for conductors, he considered the matter so far as concerned conductivity and the dissipation of energy, to be of such trifling importance that it sank into insignificance in comparison with considerations of durability. A lightning conductor was expected to last for a long time, and iron was, unfortunately, too perishable for the purpose. As regards cost, an iron system, if of sufficient size to be fairly lasting, would be more costly than an ordinary copper tape one.

Mr. Hands said that vagaries or freaks of lightning were an impossibility, and the belief in such was due only to the cases being wrongly reported. There were laws governing all natural phenomena, and lightning, like every other force in Nature, must be amenable to law. Where they appeared at first sight inexplicable, we should try to clear up the mystery, and not dismiss the matter by saying that in one respect Nature was erratic.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

AUDIBLE METEORS.

THERE is no need for you to apologise for having placed a ? after the title of Mr. Huntley's letter on p. 190 of the November number; he himself evidently considers that any connection between the sound and the meteor is doubtful, and he may well do so. Mr. Wood, on the other hand, sees no difficulty in the connection, and cites several instances to show that meteors emit sound. There is no doubt they do, but I would point out that these cases do not explain Mr. Huntley's observation.

In the instances of the great Madrid meteor and the meteor of January 25th, 1894, 10 p.m., a distinct time interval between the flash and the detonation was recorded, in no case probably less than one minute.

In the instance of January 9th, 1900, there is no mention of what the time interval was. In the instance of November 20th, 1887, the meteor was seen only at Hertford, and it is expressly stated that no report was heard there. All other observations deal with the sound only, and therefore no time interval could be recorded.

But in Mr. Huntley's case he heard the sound *before* he saw the meteor. I would ask Mr. Wood how he explains this, except on the supposition that the velocity of the meteor was less than that of

sound; and, if so, how at such a velocity could the meteor be incandescent?

Many instances of similar observations have been recorded. The only probable explanation is that the observer, startled by the suddenness of the phenomenon, unconsciously attributes to the meteor the hissing sound with which in the case of a rocket he is doubtless quite familiar.

In Vol. XIII., p. 277 of the *British Astronomical Association Journal*, there is a most interesting letter from Mr. Denning on this subject. No one knows more about meteoric astronomy than he does, and with your permission I append a few extracts:—

"I have seen some thousands of meteors of various magnitudes and kinds, but never in a single instance detected any hissing or rushing sound attending an object."

"The attention of an observer at Faringdon, Berks, was attracted by a distant hissing sound, and looking up he saw the meteor. Another observer at Bath distinctly heard a slight continued hissing. The observer in Berks was 150 miles distant from the meteor."

"A number of the observers, who have confidently affirmed that sounds were audible simultaneously with meteoric outbursts, were distant 100 or 150 miles from the objects, whereas other observers much nearer to them say that the flights were absolutely silent."

The only case (quoted in the same letter) of an experienced observer hearing a sound is that of Lieut.-Col. Tupman, who, when at anchor in the River Plate, "saw a shooting star of the first magnitude traverse some 40° of the sky, and less than a second after heard a gentle hissing sound from its direction, which greatly astonished him." Mr. Denning then adds: "He merely reported the observation as a curious incident, without attaching undue importance to it." CHARLES L. BROOK.

Harewood Lodge, Meltham, Dec. 27th, 1906.

THE SUNSPOT QUESTION.

ACCORDING to a review in your November issue, Prof. Bigelow represents that when the sun is most active, and spotted, temperature is relatively high in the tropics and low in temperate regions. As this appears to be in conflict with facts established by Köppen and Nordmann for the tropics, and with our own experience in these parts (Greenwich), some explanation will be acceptable. A.B.M.

8, Marine Crescent, Folkestone, 7th Dec., 1906.

THAT'S WHY.

HEREWITH I enclose answers to the two questions on page 211 of *Symons's Meteorological Magazine*, which are puzzlers to answer concisely. P. P. PENNANT.

Nantlys, St. Asaph, 26th Dec., 1906.

Why do rain-drops differ so much in size?

Rain-drops are formed in cooling air. At first extremely small, they touch each other, coalesce, and become larger. Large drops fall faster than small, hence, incessant collisions, producing larger drops. So falling from a great height rain-drops may be large, but formed near the Earth must be small. P.P.P.

Why is the distant view . . . . so remarkably clear before rain?

Because the air we look through has already been washed with rain, or is so nearly ready to form rain that it has moistened the dust and smoke in the air, making them too heavy to float in the air any longer, and produce haze. P.P.P.

[Several answers have been received; but the neatest appears to be the above.—ED. *S.M.M.*]

NATURE'S REVEILLÉE.

A CURIOUS phenomenon reported to me many years ago by a cousin who had a large horse ranch in Colorado, U.S.A., has recently received such satisfactory confirmation through the 7 in. chart of the latest barograph, that I think it worth mentioning to your readers. The phenomenon in question is that Nature causes a curious trembling or shiver of the air over the enormous American plains an hour or so before sunrise, which acts as a *reveillée* call for all the animals, birds and insects to be on duty for the rising sun. This would appear to be a very beautiful provision of Nature, and although we, with our heavy dock traffic, cannot say whether there is a tremor in the air attributable or not to the atmosphere, the new 7 in. barograph shows that there is a small V-shaped depression occurring each morning about 90 minutes before sunrise—a sort of *reveillée* dip, in fact—the extra 30 minutes being due probably to our more northern situation.

If those possessing these new instruments will kindly direct their attention to this question they may be able to favour us with some valuable data. J. H. W. BIGGS.

Liverpool, November 20th, 1906.

[The regular diurnal variation in atmospheric pressure in and near the tropics is so persistent that it is not unreasonable to suppose that at the period of temperature minimum shortly before the dawn some slight air movement may occur every morning; but we doubt whether any such occurrence could be traced amidst the irregular changes in the unstable atmospheric equilibrium of our latitudes. We should require a much more definite statement than Mr. Biggs supplies before accepting the existence of so highly improbable a phenomenon.—ED. *S.M.M.*]

THE GREEN FLASH.

As the discussion of this phenomenon has excited considerable interest of late, I am sending you particulars of its appearance in, so far as I know, exceptional circumstances. On the 23rd of December, when using a pair of opera glasses, I watched the sun setting into a low and narrow cloud stretching along the south-western horizon. The cloud was scarcely apparent to the naked eye, but plainly visible through the glasses, whilst the whole of the disc was visible, and just as the bottom edge touched the cloud, there was a beautiful green lining along the top edge, deeper at the middle than at the two extremities. This slowly diminished until it disappeared. After a few seconds it re-appeared, but not so strongly as before, and again diminished to nothing when the sun's disc was about two-thirds hidden, and was not seen again. The sun was redder at the bottom than at the top, and I saw no prismatic colours.

Does not this point to the green flash being produced through a peculiar condition of the atmosphere favouring its appearance rather than from some of the causes which have been adduced to account for it?

I may mention that I have seen both a green and blue flash on several mornings during this month through a three-inch refractor when the sun has risen out of a bank of clouds stretching along the sea horizon. The appearance, however, was not in the nature of a flash (except in its rather sudden disappearance), as I watched it on each occasion for several seconds as the green or blue colour travelled along the opposite edges of the cloud as more and more of the sun's disc became visible. The eye-piece was a magnifier of about 60 diameters, and the image of the cloud and arc of the sun's disc were, of course, inverted. WILSON LLOYD FOX.

Falmouth, 26th December, 1906.

SINCE you published Admiral Maclear's letter about a year ago (*Symons's Meteorological Magazine*, January, 1906, p. 227) on the subject of the green flash, your correspondents have, it seems to me, described four or five different phenomena under this name.

1. In order to see a striking phenomenon, which may be described as a green flash, the observer has only to look for a second or so at the red disc of the rising or setting sun, and then to alter slightly the direction of his eyes, and he will immediately see a visionary image or spectrum of the sun in the complementary green colour. If the disc of the sun happens to be coloured orange, the visionary image will be blue. This is an example of ordinary successive contrast, and is a physiological phenomenon. There is no reason why it should not be just as well seen at sunrise as at sunset.

Last summer there were some beds of calceolarias in the flower

garden under my bedroom window. On getting up in the morning and opening the shutters I could hardly avoid looking on one or another of these beds. My eyes, after sleep, being thoroughly rested, and therefore susceptible, a momentary glance at the flowers was sufficient to stimulate my eyes, as soon as their direction was slightly altered, to produce visionary images of the flowers in the complementary blue colour. They were seen as blue spots on the turf near the flowers, lasted about a second, and might be described as "blue flashes."

I may add here that I do not consider their appearance to be due to "fatigue" of the eye, but to its vital elasticity, which produces out of itself the colour or colours necessary to complete the triad of leading colours. Thus the green demanded by red contains yellow and blue; orange, uniting yellow and red, demands blue; and the violet demanded by yellow contains red and blue.

2. I have not myself witnessed the green flash described by Admiral Maclear and other observers as seen when the sun is rising above or sinking below a sea horizon in a clear sky.

When the sun at rising or setting is coloured red or orange, this green flash may be an example of the physiological phenomenon of colour described above. Or it may be a phenomenon produced by coloured shadows. Coloured shadows are seen when there are two lights in the atmosphere, one coloured and the other uncoloured.

The shadow cast by the coloured light (in this case red) and illumined by the uncoloured one, would exhibit the complementary colour (in this case green).

The phenomena of coloured shadows, although belonging to the physiological colours, have more objective reality than the previously described examples of physiological contrast. Again, it is possible that this example of the green flash may be produced by the intermixture of a yellow ray of the rising or setting sun with the blue of the sky.

As the green flash is seen when the sun is rising above or setting below the edge of the horizon, it may be produced by *refraction*, or by *diffraction*, or by both combined. If produced in this way, the stripes of colour accompanying the refraction or diffraction may, when pressed together just before their disappearance, produce a greenish-blue or a red colour, which may be described as a greenish-blue or as a red flash.

In the first two cases the phenomena would be examples of physiological colours; in the last two, of physical colours.

3. The phenomena described in the latter part of Prof. Michie Smith's letter in *Symons's Meteorological Magazine*, June, 1906, p. 91. appear to be examples of physiological colours due to contrast.

They are examples of *simultaneous* contrast, while the phenomenon first described is due to *successive* contrast.

In the first case, the upper part of the sun's disc, when it was setting, and when its light was probably subdued by haze or mist,

was coloured green, because the reddish light reflected by the clouds evoked the complementary green colour. In the second case, the green mist which filled the whole sky at sunset, was probably due to the same cause.

The green colour in both cases was the complementary colour of the reddish light reflected by the clouds, and was an example of *simultaneous* contrast.

If a piece of white paper is placed on a red surface, the white paper will be tinged with a green hue.

4. The phenomenon seen through a telescope, and described by Dr. Rambaut (*Symons's Meteorological Magazine*, March, 1906, pp. 21-23, and April, 1906, pp. 41-45), and by Mr. Whitmell (December, 1906, pp. 209–210), are, of course, examples of the colours which accompany refraction.

Mr. Whitmell describes how the yellow border at the base of the sun widens out, and meeting the blue edge at the top of the disc, produces green. This green he calls a green flash.

5. In the observations described by Mr. Whitmell, and quoted by Dr. Rambaut as seen through the narrow openings in a belfry ; in the observations described by Dr. Rambaut as seen through a telescope, in which an opaque diaphragm, or a diaphragm with a narrow slit, had been placed : and in the observations described by Mr. Whitmell (December, 1906, p. 209), when "the sun was sinking behind a low horizontal narrow bank of cloud, between which and the horizon was a strip of clear sky," the colours seen are due to refraction and diffraction.

I have tried to separate the different phenomena, which have been described under the name of the "green flash," into different classes, according to the conditions under which they are produced.

Some of the phenomena are due to *successive* contrast, some to *simultaneous* contrast, some may be examples of the phenomena produced by *coloured shadows*.

Others, again, are examples of the colours which accompany *refraction* only, or both *refraction* and *diffraction*.

Again, a green flash might be produced by the admixture of a yellow ray of the rising or setting sun with the blue of the sky.

The three first cases belong to the class of the physiological colours ; the three last to that of the physical colours.

Admiral Maclear remarks (January, 1906, p. 227) that different "writers appear to hold different views as to the cause" of the "green flash." The reason, as is seems to me, is that the writers are describing *different* phenomena under this name ; phenomena which are produced by different conditions, and are to be traced to different causes. R. C. CANN LIPPINCOTT.

Over Court, Almondsbury, Bristol, 3rd Jan., 1907.

[Our great respect for Mr. Cann Lippincott as an earnest and enthusiastic meteorological observer, makes us desirous of showing

him every possible courtesy, and we have enlarged this number of the Magazine in order to admit his letter, which our editorial conscience feels is too long. We do not agree with his views on the question of colour, but most fully support Dr. Rambaut's able and convincing demonstration of the phenomenon under consideration, which no correspondent, so far as we are aware, has confused with the familiar effects of complementary colours except Mr. Lippincott himself. When he sees the phenomenon which our correspondents have described he will, we believe, at once recognise its essentially distinct character. The Green Flash has illuminated our pages for a year, and we do not propose that the correspondence should continue. ED. *S.M.M.*]

REVIEWS.

The Science Year Book, with Astronomical, Physical and Chemical Tables, Summary of Progress in Science, Directory, Biographies and Diary for 1907 (third year of issue). Edited by Major B. F. S. BADEN-POWELL. London, King, Sell & Olding. Price 5s. net. Size $9\frac{1}{2} \times 6$. Pp. 152 + diary.

THIS very conveniently arranged book is particularly useful to the student of Nature who interests himself in various branches of science. The introductory matter is well planned, and every here and there one comes on little tables of a useful kind that it would not be easy to find elsewhere. The diary gives for each day the hour of the rising and setting of the sun and moon, and of such planets as are visible, a note of the constellations which are on the meridian at midnight, a memorandum of the maximum and minimum temperature for the day at Greenwich, and spaces for the meteorological observations of the day.

The Life-History of Surface-Air-Currents. A Study of the Surface Trajectories of moving air. By W. N. SHAW, Sc.D., F.R.S. (Director of the Meteorological Office) and R. G. K. LEMPFERT, M.A. Published by the Authority of the Meteorological Committee, London, 1906. Size $12\frac{1}{2} \times 10$. Pp. 108. Price 7s. 6d.

INFALLIBILITY is one of the most cherished prerogatives of an Editor, and the acknowledgment of any shortcoming is so unusual a proceeding that we only make it when fairly cornered between the Devil of accumulated literature and the Deep Sea of a new year teeming it may be with as good fish as ever came out of the old. We meant well in the way of reviews for 1906, and particularly we resolved to devote abundant space to any important contributions to Meteorology

published in Great Britain. Now we find ourselves looking helplessly at what we believe to be the most important contribution to meteorology of 1906 produced in any country, and the very importance of the work makes it at once an impossibility to give an adequate review in the space and time at our disposal, and an impertinence to offer an inadequate one.

We therefore attempt no review, but only say that the method employed in this memoir is that of tracing the actual path of the air as it takes part in a travelling storm, and the results though now seen to be in accordance with the laws of air-movements, are such as had not been anticipated before Dr. Shaw and Mr. Lempfert originated the promising method of research here laid down. We need not urge the serious student of meteorology to read the "Life-History"; he will recognise that it is essential if he wishes to keep in touch with what may be termed the "growing point" of the science.

Popular Meteorological Handbook. Some Facts about the Weather by WILLIAM MARRIOTT, F.R.Met.Soc., Assistant Secretary. London: Edward Stanford. 1906. Size $8\frac{1}{2} \times 5\frac{1}{2}$. Pp. 32. Price 6d.

THIS pamphlet is designed to give in a brief and popular form such fundamental facts about the weather as should help the "man in the street" to understand the references in his newspaper, and whet the interest of the amateur observer to seek fuller information elsewhere. There is no one better able than Mr. Marriott to appreciate the points regarding which information is most welcomed by the public interested in weather, nor is there a more experienced or safer guide than he in all that pertains to practical observing. The service he is rendering to his Society as a popular lecturer on various aspects of weather-lore is no small one, giving expression as it does to the experience of a lifetime spent in the Society as assistant-secretary and inspector of stations. It is to be hoped that this little book will widen the interest in the work of the Royal Meteorological Society, and be the means of introducing many to the privileges which the Society offers.

Der meteorologische Äquator im Stillen Ozean, von R. WESTERMANN. *Aus dem Archiv der Deutschen Seewarte.* **29** Jahrgang 1906. No. 1. Hamburg, 1906.

THIS paper discusses the position of the meteorological equator in the Pacific Ocean with regard to such elements as temperature, humidity, wind-force, precipitation, cloudiness and pressure distribution. The meteorological equator is theoretically defined as the imaginary line which connects places along each meridian with the highest mean annual temperature, and which represents a division of

areas corresponding to an approximately symmetrical distribution of the various meteorological elements. From this line towards either side the mean air pressure and wind velocity increase, the mean cloudiness, humidity and amount of precipitation decrease, and the mean wind direction indicates the exact component due to the position of the wind along a meridian. With regard to the Pacific Ocean, some of the material under discussion has been derived from six hundred meteorological logs kept on sailing vessels, and from certain land stations mainly in the islands under German protection. The thermal equator is the bisector of a temperature belt bounded by the isotherm of 25° C., which alters its breadth and latitude according to the time of year. In the eastern half of the ocean the form of the belt is affected by the South Equatorial Current, which shifts and compresses the belt towards the north, but in the western half of the ocean its breadth is not hampered. In the summer half-year of the northern hemisphere, however, owing to its northward trend, the belt is little influenced by the South Equatorial Current. Much information in figures relating to the meteorology of the Pacific Ocean is given in tabular form in the paper under our notice. L. C. W. B.

METEOROLOGICAL NEWS AND NOTES.

PROFESSOR H. H. HILDEBRANDSSON has resigned the office of Director of the Meteorological Observatory at Upsala, and Mr. F. Aakerblom is discharging *ad interim* the duties of the Director.

THE MACHRIHANISH TOWER, the fall of which during the gale of December 5th, 1906, was described by Mr. Douglas in our last issue (p. 201), was constructed, according to a well-informed local correspondent, of lengths of steel tube which did not overlap but were rivetted together through flanges. The immediate cause of the catastrophe was the drawing of the ends of the wire cables out of the masses of soft metal in which they had been embedded, and not any defect in the material employed.

MR. W. MARRIOTT has arranged to lecture in accordance with the Royal Meteorological Society's scheme of local lectures on February 6th at the British Sea-Angler's Society, Fetter Lane, London, E.C.; on February 9th at the Ealing Scientific and Microscopical Society; on February 18th to the Glasgow Amateur Photographic Association, and on March 13th at Kendal.

THE AMIR OF AFGHANISTAN deserves to be ranked a meteorological observer. At one of the receptions in India the weather was bad, and *The Times* records that "he bore the discomfort of the weather with the greatest equanimity, remarking that rain was always considered a sign of good fortune in Afghanistan."

TEMPERATURE FOR DECEMBER, 1906.

STATION.	COUNTY.	Lat. N.	Long. W. [*E.]	Height above Sea. ft.	TEMPERATURE. Max.		TEMPERATURE. Min.		No. of Nights at or below 32° Shade.	No. of Nights at or below 32° Grass.
		° ′	° ′		°	Date.	°	Date.		
Camden Square	*London*	51 32	0 8	111	55·1	3	20·9	27	13	22
Tenterden	*Kent*	51 4	*0 41	190	54·0	3	16·0	30	19	23
West Dean	*Hampshire*	51 3	1 38	137	53·0	3, 4	19·0	24	17	25
Hartley Wintney	,,	51 18	0 53	222	55·0	3, 4	19·0	28	22	24
Hitchin	*Hertfordshire*	51 57	0 17	238	53·0	4, 5	19·0	29	21	...
Winslow (Addington)	*Buckinghamshr.*	51 58	0 53	309	55·0	4	14·0	27	22	23
Bury St. Edmunds (Westley)	*Suffolk*	52 15	*0 40	226	52·0	2, 3, 4	13·5	30	...	...
Brundall	*Norfolk*	52 37	*1 26	66	...	..	...	...	...	...
Winterbourne Steepleton	*Dorset*	50 42	2 31	316	53·9	3	24·0	24	15	20
Torquay (Cary Green)	*Devon*	50 28	3 32	12	57·1	4	28·8	28	4	11
Polapit Tamar [Launceston]	,,	50 40	4 22	315	52·9	3	24·9	29	12	17
Bath	*Somerset*	51 23	2 21	67	55·0	3	21·0	30	15	...
Stroud (Upfield)	*Gloucestershire*	51 44	2 13	226	52·0	2	24·0	29	19	...
Church Stretton (Woolstaston)	*Shropshire*	52 35	2 48	800	55·0	4	15·0	27	25	...
Bromsgrove (Stoke Reformatory)	*Worcestershire*	52 19	2 4	225	51·0	5	10·0	26	22	...
Boston	*Lincolnshire*	52 58	0 1	25	52·0	2	15·0	27	21	...
Worksop (Hodsock Priory)	*Nottinghamshire*	53 22	1 5	56	54·7	4	13·7	30	18	25
Derby (Midland Railway)	*Derbyshire*	52 55	1 28	156	52·0	2	18·0	26, 29	20	...
Bolton (Queen's Park)	*Lancashire*	53 35	2 28	390	52·8	2	19·7	27	19	21
Wetherby (Ribston Hall)	*Yorkshire, W.R.*	53 59	1 24	130	...	...	...	...	...	...
Arncliffe Vicarage	,, ,,	54 8	2 6	732	...	...	...	...	...	...
Hull (Pearson Park)	,, *E.R.*	53 45	0 20	6	54·0	2, 5	22·0	30	17	27
Newcastle (Town Moor)	*Northumberland*	54 59	1 38	201	...	...	...	...	...	...
Borrowdale (Seathwaite)	*Cumberland*	54 30	3 10	423	53·6	4	15·5	27	17	...
Cardiff (Ely)	*Glamorgan*	51 29	3 13	53	...	...	...	...	...	...
Haverfordwest (High Street)	*Pembroke*	51 48	4 58	95	53·4	2	22·8	23	8	17
Aberystwyth (Gogerddan)	*Cardigan*	52 26	4 1	83	52·0	2, 4	16·0	28	...	...
Llandudno	*Carnarvon*	53 20	3 50	72	54·0	3	28·2	26	6	...
Cargen [Dumfries]	*Kirkcudbright*	55 2	3 37	80	54·0	2, 17	15·0	26	18	...
Lilliesleaf (Riddell House)	*Roxburgh*	55 31	2 46	550	51·0	2	20·0	22, 30	21	23
Edinburgh (Royal Observy.)	*Midlothian*	55 55	3 11	442	55·3	2	22·7	26	15	18
Colmonell (Clachanton)	*Ayr*	55 8	4 54	140	52·0	1, 16	16·0	28	12	...
Glasgow (Queen's Park)	*Renfrew*	55 53	4 18	144	52·0	2, 4	16·0	25	16	24
Tighnabruaich	*Argyll*	55 55	5 14	50	50·0	1	19·0	25, 28	19	20
Mull (Quinish)	,,	56 36	6 13	35	...	...	...	...	...	...
Dundee (Eastern Necropolis)	*Forfar*	56 28	2 57	199	55·0	2	15·5	31	17	...
Braemar	*Aberdeen*	57 0	3 24	1114	...	...	...	...	...	...
Aberdeen (Cranford)	,,	57 8	2 7	120	56·0	2	8·0	29, 30	22	...
Cawdor (Budgate)	*Nairn*	57 31	3 57	250	...	...	...	...	...	...
Invergarry	*E. Inverness*	57 4	4 47	130?	...	...	...	...	...	...
Loch Torridon (Bendamph)	*W. Ross*	57 32	5 32	20	...	...	...	...	...	...
Dunrobin Castle	*Sutherland*	57 59	3 56	14	55·0	4	18·0	31	16	...
Castletown	*Caithness*	58 35	3 23	100	52·0	2, 7, 16	11·0	31	17	19
Killarney (District Asylum)	*Kerry*	52 4	9 31	178	57·0	18	16·5	29	...	...
Waterford (Brook Lodge)	*Waterford*	52 15	7 7	104	56·5	2	22·0	29, 30	11	..
Broadford (Hurdlestown)	*Clare*	52 48	8 38	167	50·0	2†	14·0	28	11	...
Carlow (Browne's Hill)	*Carlow*	52 50	6 53	291	...	...	...	...	...	...
Dublin (Fitz William Square)	*Dublin*	53 21	6 14	54	55·9	5	23·1	30	6	15
Ballinasloe	*Galway*	53 20	8 15	160	...	...	...	...	...	...
Clifden (Kylemore House)	,,	53 32	9 52	105	...	...	...	...	...	...
Crossmolina (Enniscoe)	*Mayo*	54 4	9 18	74	...	...	...	...	...	...
Seaforde	*Down*	54 19	5 50	180	52·0	1, 2, 16	20·0	29	14	17
Londonderry (Creggan Res.)	*Londonderry*	54 59	7 19	320	...	...	...	...	...	...
Omagh (Edenfel)	*Tyrone*	54 36	7 18	280	53·0	2, 4, 16	18·0	28	13	16

† and 3, 4, 17.

RAINFALL FOR DECEMBER, 1906.

Nights below 32°	RAINFALL OF MONTH.							RAINFALL FROM JAN. 1.				Mean Annual 1870-1899.	STATION.
	Aver. 1870-99.	1906.	Diff. from Av.	% of Av.	Max. in 24 hours.		No. of Days	Aver. 1870-99.	1906.	Diff. from Aver.	% of Av.		
Grass.	in.	in.	in.		in.	Date.		in.	in.	in.		in.	
22	2·12	2·21	+ ·09	114	·34	25	19	25·16	24·27	— ·89	96	25·16	Camden Square
23	2·74	2·02	— ·72	74	·39	25	15	28·36	27·37	— ·99	97	28·36	Tenterden
25	2·74	1·91	— ·83	70	·32	15	19	29·93	29·96	+ ·03	100	29·93	West Dean
24	2·55	2·09	— ·46	82	·37	25	17	27·10	26·35	— ·75	97	27·10	Hartley Wintney
...	2·05	2·21	+ ·16	108	·35	15	18	24·66	25·44	+ ·78	103	24·66	Hitchin
23	2·27	2·20	— ·07	104	·38	15	19	26·75	25·73	—1·02	96	26·75	Addington
...	2·11	2·46	+ ·35	117	·39	25	16	25·39	27·11	+1·72	107	25·39	Westley
...	2·13	3·73	+1·60	175	1·20	25	21	25·40	29·96	+4·56	118	25·40	Brundall
...	4·13	2·68	—1·45	65	·59	30	16	39·00	39·39	+ ·39	107	39·00	Winterbourne Stpltn
20	3·46	1·53	—1·93	44	·30	12	18	35·00	28·53	—6·47	82	35·00	Torquay
11	4·39	4·55	+ ·16	104	·65	15	23	38·85	40·10	+1·25	103	38·85	Polapit Tamar
17	2·76	1·87	— ·89	68	·37	25	15	30·75	27·24	—3·51	89	30·75	Bath
...	2·48	1·50	— ·98	60	·32	15	18	29·85	26·87	—2·98	90	29·85	Stroud
...	2·92	2·25	— ·67	77	·32	5	20	33·04	29·22	—3·82	88	33·04	Woolstaston
...	1·95	1·75	— ·20	90	·40	15	13	24·50	23·24	—1·26	95	24·50	Bromsgrove
...	1·79	2·31	+ ·52	129	·64	25	15	23·30	23·71	+ ·41	102	23·30	Boston
25	2·02	2·53	+ ·51	125	·48	4	24	24·70	23·43	—1·27	95	24·70	Hodsock Priory
...	2·28	2·10	— ·18	92	·44	5	22	26·18	23·83	—2·35	91	26·18	Derby
...	4·19	5·90	+1·71	141	·61	15	24	42·43	50·54	+8·11	119	42·43	Bolton
21	2·19	2·38	+ ·19	109	·38	15	16	26·96	27·93	+ ·97	104	26·96	Ribston Hall
...	5·41	5·12	—1·29	80	·63	5	22	60·96	67·45	+6·49	111	60·96	Arncliffe Vic.
...	2·36	1·98	— ·38	84	·34	15	23	27·02	25·46	—1·56	94	27·02	Hull
27	2·64	3·84	+1·20	145	1·64	27	21	27·99	30·19	+2·20	108	27·99	Newcastle
...	4·70	11·75	—2·95	80	1·60	2	21	132·68	130·66	—2·02	98	132·68	Seathwaite
...	4·43	2·75	—1·68	62	·38	25	20	42·81	43·49	+ ·68	102	42·81	Cardiff
...	5·22	4·85	— ·37	93	·80	27	23	47·88	50·41	+2·53	105	47·88	Haverfordwest
17	4·49	5·27	+ ·78	117	·66	11	23	45·41	47·64	+2·23	95	45·41	Gogerddan
...	2·95	2·49	— ·46	84	·36	15	23	30·98	31·57	+ ·59	102	30·98	Llandudno
...	4·68	4·17	— ·51	89	·85	5	15	43·43	45·42	+1·99	105	43·43	Cargen
...	3·18	3·06	— ·12	96	·61	28	20	33·04	34·68	+1·64	105	33·04	Riddell House
23	...	1·17	...	...	·53	12	12	...	31·24	...	..	...	Edinburgh
18	4·82	7·10	+2·28	147	1·46	11	20	44·85	44·04	— ·81	98	44·85	Colmonell
...	3·53	3·62	+ ·09	103	·80	15	16	35·80	40·21	+4·41	112	35·80	Glasgow
24	5·33	7·67	+1·34	121	1·80	15	22	57·90	67·94	+10·04	117	57·90	Tighnabruaich
20	6·48	6·31	— ·17	97	·74	1	24	57·53	54·48	—3·05	95	57·53	Quinish
...	2·73	1·70	—1·03	62	·50	12	16	28·95	26·65	—2·30	92	28·95	Dundee
...	3·15	2·29	— ·86	73	...	...	...	36·07	37·33	+1·26	103	36·07	Braemar
...	3·39	4·16	+ ·77	123	·93	28	17	33·01	35·63	+2·62	108	33·01	Aberdeen
...	2·53	1·91	— ·62	76	·32	26	15	29·37	31·89	+2·52	109	29·37	Cawdor
...	5·67	6·51	— ·16	98	1·17	2	18	56·00	60·03	+4·03	107	56·00	Invergarry
...	9·04	9·96	+ ·92	110	1·93	2	21	86·50	94·91	+8·41	110	86·50	Bendamph
...	3·39	3·22	— ·17	95	·52	15	19	31·60	41·41	+9·81	131	31·60	Dunrobin Castle
...	...	5·33	...	...	·97	4	25	...	39·80	...	...	...	Castletown
19	5·64	3·67	—2·97	55	·42	12	25	58·11	45·08	—13·03	78	58·11	Killarney
...	3·31	2·28	—2·03	53	·59	15	21	39·30	33·21	—6·09	85	39·30	Waterford
..	3·37	3·29	— ·08	98	·84	14	20	33·47	36·50	+3·03	109	33·47	Hurdlestown
...	4·46	2·28	—1·18	66	·96	15	19	34·44	27·75	—6·69	81	34·44	Carlow
...	2·39	1·81	— ·58	76	·37	15	18	27·75	22·81	—4·94	82	27·75	Dublin
15	3·63	..	...	...	...	...	...	37·04	...	...	...	37·04	Ballinasloe
...	5·99	5·96	—3·03	66	·86	29	18	80·23	71·10	—9·13	89	80·23	Kylemore House
...	5·81	5·69	— ·12	98	·65	25	28	50·50	51·11	+ ·61	101	50·50	Enniscoe
...	3·64	3·64	·00	100	·82	15	21	38·61	34·23	—4·38	89	38·61	Seaforde
17	6·31	6·88	+2·57	160	·74	15	26	41·20	45·35	+4·15	110	41·20	Londonderry
...	3·77	3·40	— ·37	90	·57	15	22	37·85	42·40	+4·55	112	37·85	Omagh
16													

SUPPLEMENTARY RAINFALL, DECEMBER, 1906.

Div.	STATION.	Rain. inches	Div.	STATION.	Rain. inches
II.	Abinger Hall	2·86	XI.	Rhayader, Tyrmynydd	...
,,	Ramsgate, West Cliff Villas	2·08	,,	Lake Vyrnwy	4·82
,,	Hailsham	2·56	,,	Llangyhanfal, Plâs Draw	3·83
,,	Crowborough, Uckfield Lodge	2·57	,,	Criccieth, Talarvor	4·89
,,	Osborne, Newbarn Cottage.	1·94	,,	Llanberis, Pen-y-pass	10·55
,,	Emsworth, Redlands	2·00	,,	Lligwy	3·93
,,	Alton, Ashdell	2·60	,,	Douglas, Woodville	5·29
,,	Newbury, Welford Park	2·59	XII.	Stoneykirk, Ardwell House	4·95
III.	Harrow Weald, Hill House.	2·26	,,	Dalry, The Old Garroch	7·72
,,	Oxford, Magdalen College..	1·67	,,	Langholm, Drove Road	4·20
,,	Bloxham Grove	1·52	,,	Moniaive, Maxwelton House	3·80
,,	Pitsford, Sedgebrook	2·49	XIII.	N. Esk Reservoir [Penicuick]	4·60
,,	Huntingdon, Brampton	2·30	XIV.	Maybole, Knockdon Farm..	3·86
,,	Wisbech, Bank House	2·02	XV.	Campbeltown, Witchburn	5·24
IV.	Southend Water Works	1·82	,,	Inveraray, Newtown	8·70
,,	Colchester, Lexden	2·09	,,	Ballachulish House	10·38
,,	Newport, The Vicarage	2·89	,,	Islay, Eallabus	6·30
,,	Rendlesham	2·69	XVI.	Dollar Academy	2·37
,,	Swaffham	2·21	,,	Loch Leven Sluice	1·67
,,	Blakeney	1·98	,,	Balquhidder, Stronvar	4·91
V.	Bishops Cannings	2·29	,,	Perth, Pitcullen House	1·47
,,	Ashburton, Druid House	3·48	,,	Coupar Angus Station	1·62
,,	Okehampton, Oaklands	4·44	,,	Blair Atholl	2·54
,,	Hartland Abbey	3·23	,,	Montrose, Sunnyside Asylum	2·04
,,	Lynmouth, Rock House	2·83	XVII.	Alford, Lynturk Manse	3·38
,,	Probus, Lamellyn	4·39	,,	Keith Station	1·85
,,	Wellington, The Avenue	1·70	XVIII.	N. Uist, Lochmaddy	4·38
,,	North Cadbury Rectory	1·96	,,	Alvey Manse	2·65
VI.	Clifton, Pembroke Road	1·53	,,	Loch Ness, Drumnadrochit.	3·10
,,	Moreton-in-Marsh, Longboro'	2·42	,,	Glencarron Lodge	13·72
,,	Ross, The Graig	1·31	,,	Fearn, Lower Pitkerrie	1·46
,,	Shifnal, Hatton Grange	2·74	XIX.	Invershin	3·39
,,	Cheadle, The Heath House.	3·61	,,	Altnaharra	5·88
,,	Coventry, Kingswood	2·25	,,	Bettyhill	3·72
VII.	Market Overton	2·74	,,	Watten Station	2·81
,,	Market Rasen	2·47	XX.	Dunmanway, The Rectory..	3·19
,,	Bawtry, Hesley Hall	2·17	,,	Cork	1·75
VIII.	Neston, Hinderton	3·01	,,	Darrynane Abbey	5·02
,,	Southport, Hesketh Park	3·03	,,	Glenam [Clonmel]	3·12
,,	Chatburn, Middlewood	...	,,	Ballingarry, Gurteen	2·38
,,	Cartmel, Flookburgh	4·70	,,	Miltown Malbay	4·88
IX.	Langsett Moor, Up. Midhope	3·88	XXI.	Gorey, Courtown House	2·33
,,	Scarborough, Scalby	3·21	,,	Moynalty, Westland	3·03
,,	Ingleby Greenhow	2·90	,,	Athlone, Twyford	2·63
,,	Mickleton	2·88	,,	Mullingar, Belvedere	2·92
X.	Bardon Mill, Beltingham	2·79	XXII.	Woodlawn	4·81
,,	Ewesley, Fallowlees	1·63	,,	Westport, Murrisk Abbey..	5·23
,,	Ilderton, Lilburn Cottage..	2·04	,,	Collooney, Markree Obsy..	5·25
,,	Keswick, York Bank	4·03	XXIII.	Enniskillen, Portora	3·85
XI.	Llanfrechfa Grange	1·92	,,	Warrenpoint, Summer Hill.	1·32
,,	Treherbert, Tyn-y-waun	5·09	,,	Banbridge, Milltown	2·78
,,	Carmarthen, The Friary	4·37	,,	Belfast, Springfield	4·61
,,	Castle Malgwyn [Llechryd].	4·10	,,	Bushmills, Dundarave	4·95
,,	Plynlimon	12·85	,,	Stewartstown, The Square..	3·59
,,	Tall-y-llyn	3·00	,,	Killybegs	9·41
,,	New Radnor, Ednol	3·54	,,	Horn Head	5·11

METEOROLOGICAL NOTES ON DECEMBER, 1906.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Temp. for Temperature; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow.

LONDON, CAMDEN SQUARE.—Nearly normal temp. prevailed till the last ten days, when a period of severe frost brought the mean temp. down to 37°·8 or, 1°·4 below the average. There were a number of brilliant days in the first half, but the latter part was cheerless and damp. Four and a half inches of S fell during the night of 25th, and the four following days were all more or less snowy. Duration of sunshine 37·2,* and of R 51·6, hours.

CROWBOROUGH.—Cold, with frequent squalls and much frost, especially in the last 12 days. Blizzard with 5 inches of S on Christmas night. R ·89 in. below the average of 35 years. Mean temp. 35°·7.

TORQUAY.—Duration of sunshine 63·0* hours, or 9·9 hours above the average; 8 sunless days. Mean temp. 42°·9, or 0°·7 below the average.

CLIFTON.—The first and second weeks were showery, the third rainless, but damp and foggy, and the last frosty with S, although there was never more than an inch on the ground. R less than half the average.

ROSS.—Quite warm with much fine weather till 20th; the next three days cold, dry and "easterly," then about two and a half inches of S. The next four days were wintry but without much S; gentle thaw on 31st.

SOUTHPORT.—Extremely sunny yet exceptionally stormy. Duration of sunshine 46·6 hours,* or 14·4 above the average. Mean daily wind movement 50 miles above the average. R ·05 in. above the average; duration 72·9 hours. Mean temp. 38°·7, or 0°·9 below the average. The total depth of S was 9·3 in.

BOLTON.—A very wet month, with heavy S during the last week, when a fall of 8 inches on 25th, followed by lighter falls on 26th, 28th, 29th and 30th, produced a depth of 18 to 20 inches of undrifted S, the heaviest fall yet recorded for Bolton. Mean temp. 37°·4, or 1°·5 below the average. Duration of sunshine 24·5* hours, or 11·2 above the average.

HAVERFORDWEST.—Mild and stormy, with moderate R to 25th. S storm with gale on 26th, and S on 27th, 28th, and 29th; total depth 10 inches. In a severe gale on 5th a velocity of 82 miles per hour was recorded at Goodwick breakwater. Duration of sunshine 39·8* hours.

DOUGLAS.—An excessively stormy month, mild from 16th to 21st, but otherwise generally cold, with bitter polar winds. Between one and two inches of S fell between 25th and 30th.

DUMFRIES.—Five inches of S on the night of 25th, followed by E. and N.E. gale, which caused drifts 8 to 10 feet deep, blocking roads, &c.

LYNTURK.—The feature of the month was the S storm from 26th to 28th. The drifting and blocking were unequalled since 1880.

DRUMNADROCHIT.—R 1·32 in. below, and rain days 1 above, the average of 20 years. The S storm which began on Christmas day was the most severe for many years.

WATTEN.—The first half was wet, with storms of wind and fine intervals, followed by a week of fine fresh and open weather. Great gales in the closing week, with heavy S and severe frost.

CORK.—R 2·70 in. below the average, and mean temp. 3°·2 below the average.

MILTOWN MALBAY.—Bitterly cold and rainy, with little sunshine. The month ended in a furious blizzard, which lasted four days, accompanied by intense frost, gales and squalls.

DUBLIN.—The mean temp. was about the average, but varied from 46°·9 in the first week to 39°·4 in the second, 47°·9 in the third, and 34°·7 in the fourth. A period of S and frost set in on the morning of 26th, lasting till 30th.

OMAGH.—Till 19th the month was raw, damp and gloomy. Then a fine spell, followed again on 25th by heavy S and settled frost, which only disappeared with the advent of the New Year.

* Campbell-Stokes.

Climatological Table for the British Empire, July, 1906.

STATIONS. (Those in italics are South of the Equator.)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	Total Rain. Depth.	Total Rain. Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	83·7	18	45·2	1	76·0	54·6	57·9	75	129·2	40·5	·61	7	...
Malta	94·1	13	66·2	19	87·5	70·8	69·6	78	...	61·8	·00	0	1·2
Lagos	84·5	18	70·0	16	81·3	73·6	72·7	87	131·0	68·0	15·90	23	8·7
Cape Town	69·0	2	35·0	17	58·8	44·2	45·9	80	...	...	1·82	13	4·6
Durban, Natal	81·0	5	46·1	15	74·8	52·9	...	...	131·2	...	·28	6	2·0
Johannesburg	67·2	30	23·1	16	59·3	40·2	33·4	59	127·2	...	·00	0	0·9
Mauritius	76·8	15	55·1	28	74·4	62·5	60·1	77	136·9	47·7	5·53	26	6·8
Calcutta	93·1	13	74·5	2	89·7	79·5	78·2	85	159·0	73·1	12·69	17	8·3
Bombay	87·3	1	75·0	21	84·3	77·8	76·9	87	132·0	73·8	18·10	28	9·4
Madras	103·2	2	73·0	28	97·1	79·1	74·1	72	143·7	72·7	4·45	15	6·2
Kodaikanal	69·2	4	50·6	21	63·6	53·3	52·0	83	143·6	44·3	6·89	21	7·7
Colombo, Ceylon	89·2	21	74·4	19	85·8	77·6	73·9	81	149·0	73·0	4·42	14	7·3
Hongkong	91·2	21	75·9	23	87·7	79·5	76·2	80	143·7	...	6·95	17	7·3
Melbourne	64·9	12	33·0	26	56·4	44·2	41·4	75	118·2	27·3	1·34	10	6·7
Adelaide	74·0	11	39·3	24	60·0	46·2	45·3	77	120·8	34·1	2·87	18	6·4
Coolgardie	78·9	8	30·1	19	59·8	42·0	38·9	69	138·6	26·0	·88	10	5·0
Sydney	72·0	12	37·7	19	61·9	46·0	39·7	70	109·7	29·1	·20	12	2·9
Wellington	59·5	23	33·5	29	53·7	44·0	41·6	73	109·0	24·0	2·66	19	5·7
Auckland	63·0	19	41·0	28*a*	56·9	46·5	45·5	79	115·0	37·0	6·80	26	7·0
Jamaica, Negril Point	89·1	2, 15	69·1	25	87·2	73·2	73·9	79	...	...	4·83	15	...
Trinidad	95·0	27	69·0	sev.	86·3	71·1	73·8	84	162·0	67·0	11·42	16	...
Grenada	86·4	20	71·0	13*b*	83·7	74·0	72·4	82	146·0	...	11·18	28	4·3
Toronto	92·1	22	50·8	6	79·9	60·3	61·1	75	112·0	43·0	3·41	9	4·9
Winnipeg	89·0	11	46·5	31	77·5	56·3	...	...	...	...	3·37	10	4·8
Victoria, B.C.	88·5	3	50·1	7	76·7	54·3	...	69	...	...	·16	1	2·6
Dawson	80·0	12	39·0	3	72·2	47·8	...	...	...	...	1·20	14	6·3
St. John's, N.B.	82·0	15	50·7	6	69·0	55·1	...	...	...	...	2·59	16	6·6

a and 31. *b* and 14, 24.

MALTA.—Mean temp. of air 77°·4, or 0°·4 below the average. Mean hourly velocity of wind 7·9 miles, or 0·5 above average. Mean temp. of sea 77°·6.

Mauritius.—Mean temp. of air 0°·3, dew point 0°·7, relative humidity 1·2 per cent., and R 3·23 in. above, averages. Mean hourly velocity of wind 11·9 miles.

MADRAS.—TS on 4 days, distant T on 6 days, and L on 4 other days.

KODAIKANAL.—A cloudy and showery month. Bright sunshine 164 hours.

COLOMBO.—Mean temp. of air 81°·3, or 0°·6 above, of dew point 0°·6 above, and R ·09 in. below, averages. Mean hourly velocity of wind 8·6 miles.

HONGKONG.—Mean temp. of air 82°·9. Bright sunshine 215·2 hours. R 6·4 in. below, averages. Mean hourly velocity of wind 11·8 miles.

Adelaide.—Mean temp. of air 53°·1, or 1°·6 above, and R ·31 in. above average. The shade max., 74°·0, on the 11th is the highest daily reading for July in 50 years.

Sydney.—Mean temp. of air 1°·7 above, and R 4·36 in. below, averages.

Wellington.—Mean temp. of air 1°·3 above, and R 3·43 in. below, averages.

TRINIDAD.—R 2·38 in. above 43 years average.